Effect of the Tobacco Price Support Program on Cigarette Consumption in the United States: An Updated Model

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ABSTRACT

Objectives. This study evaluated the direct effect of the tobacco price support program on domestic cigarette consumption.

Methods. We developed an economic model of demand and supply of US tobacco to estimate how much the price support program increases the price of tobacco. We calculated the resultant increase in cigarette prices from the change in the tobacco price and the quantity of domestic tobacco contained in US cigarettes. We then assessed the reduction in cigarette consumption attributable to the price support program by applying the estimated increase in the cigarette price to assumed price elasticities of demand for cigarettes.

Results. We estimated that the tobacco price support program increased the price of tobacco leaf by $0.36 per pound. This higher tobacco price translates to a $0.01 increase in the price of a pack of cigarettes and an estimated 0.21% reduction in cigarette consumption.

Conclusion. Because the tobacco price support program increases the price of cigarettes minimally, its potential health benefit is likely to be small. The adverse political effect of the tobacco program might substantially outweigh the potential direct benefit of the program on cigarette consumption. (*Am J Public Health.* 2000;90:746–750)

The US government has intervened in the tobacco market through a price support program since the 1930s.[1] Some have argued that this program is beneficial to public health because it reduces tobacco consumption by increasing prices,[2,3] but others have claimed that it hurts efforts to control tobacco because it has undesirable political consequences.[4,5] How much the price support program directly affects tobacco consumption is therefore an important policy issue; in this report, we consider this question for cigarettes only, which accounted for 90% of US tobacco use in 1996.[6]

In 1984, Sumner and Alston[7] reported their analysis of the consequences of eliminating the price support program; these researchers concluded that eliminating it would lead to a 3% decrease in cigarette prices and about a 1% increase in domestic sales. These estimates should now be recalculated for several reasons.

First, more up-to-date information on production, consumption, and prices is available. Second, empirically based estimates of the elasticity of demand and supply for US tobacco have been published.[8,9] (Sumner and Alston used a range of hypothetical elasticities.) Finally, the estimated effect of the tobacco price support program on domestic cigarette consumption depends on the share of domestic tobacco in US cigarettes. From 1983 to 1991, domestic tobacco declined as a percentage of the value of US-made cigarettes because of increased tobacco imports, greater expenses for items such as cigarette promotion, and larger gross markup by manufacturers.[10,11] However, a 1993 law establishing the minimum content of US-grown tobacco in cigarettes manufactured in the United States, as well as a 1995 law setting the amount of tobacco that each major supply country can export to the United States under a normal tariff rate, should help keep domestic share from falling much further.[1]

Tobacco Price Support Program

Marketing quotas, price support, and import restrictions form the core of the current tobacco price support program.[12]

Marketing Quotas

Marketing quotas specify the number of pounds of tobacco a grower can market that are eligible for price support; sales above this quota are subject to prohibitive penalties. Each grower's marketing quota is a share of the national quota, which is set annually by the US Department of Agriculture (USDA) on the basis of 3 criteria[12]: (1) intended purchases by cigarette manufacturers, (2) annual export for the 3 preceding years, and (3) the amount of tobacco needed to attain a specific level of reserve stock. The US secretary of agriculture can adjust this national quota by ±3%.

When the program began in 1938, the determination of individual marketing quotas was based on historical production.[12] Entry has been liberalized by changing the original rule that persons without a quota could grow tobacco only if they purchased or rented land with an attached quota. Since 1962, farmers can simply rent or purchase a quota and begin growing tobacco; they need not rent or purchase land from the quota owner.[12]

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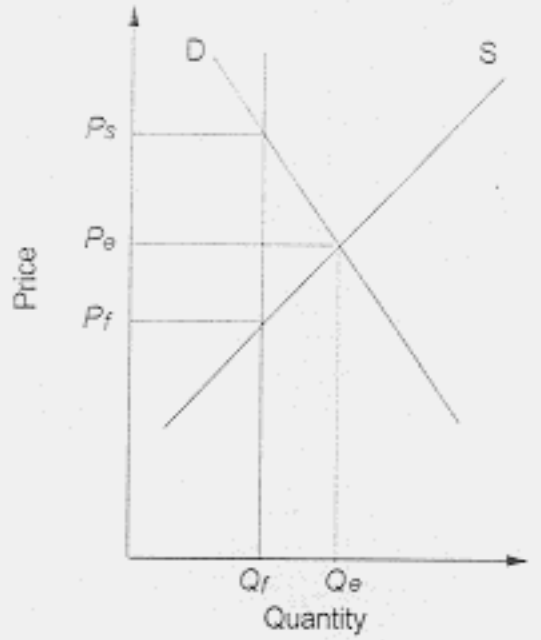
Price Support

Each year, the USDA sets the tobacco price supports by announcing the "loan rate" (actually a minimum price per pound) for the domestic action market,[12] which varies by type and grade of tobacco leaf. This price is effectively guaranteed to the grower by the Commodity Credit Corporation, a USDA agency.[1] The tobacco farmer sells cured tobacco to the highest bidder at auction; if this bid is below the loan rate, the farmer is paid the support price by a producer cooperative with money borrowed from the Commodity Credit Corporation. The newly purchased tobacco is then consigned to the cooperative, which redries, packs, and stores it as collateral for the Commodity Credit Corporation loan. The cooperative, acting as an agent for the Commodity Credit Corporation, later sells the tobacco and uses the proceeds to repay the Commodity Credit Corporation loan principal and interest; sometimes this process ends in a loss for the cooperative.[13] The federal government, however, is reimbursed from an escrow account for any losses resulting from its operation of the price support program; this account is funded by tobacco farmers and buyers.[13]

Import Restrictions

Tobacco imports are restricted to limit replacement of domestic tobacco by cheaper imported tobacco.[1] In September 1995, legislation (tariff rate quota) was enacted to set for each major supplier country the amount of tobacco it could export to the United States under a normal tariff rate. Excess shipments are subjected to a 350% duty; most of the duty may be refunded, however, if the tobacco imported is used to manufacture cigarettes for export by the United States.[14]



Note. D = demand curve for tobacco; S = supply curve of tobacco; P_e = tobacco price without the tobacco program; Q_e = quantity of tobacco demanded without the tobacco program; Q_f = quantity of tobacco supplied; P_s = tobacco price with quota; P_f = net price received by tobacco farmers.

FIGURE 1—Demand and supply of tobacco with the tobacco price support program.

Methods

To assess the direct effect of the tobacco price support program on cigarette consumption, we estimated 3 variables: (1) tobacco price increases due to the program, (2) changes in cigarette prices resulting from the higher tobacco prices, and (3) changes in cigarette consumption resulting from the higher cigarette prices.

Tobacco Price Increases Due to the Price Support Program

The primary purpose of controlling the tobacco supply is to raise and stabilize the price of tobacco.[12] If demand for tobacco does not change, prices will rise as the supply of tobacco declines. A simple model of demand and supply with the support program in place illustrates this point (Figure 1). Without the support program, the tobacco market would be in equilibrium at price (P_e) and quantity (Q_e). Marketing quotas, however, limit market supply to Q_f, in turn increasing the tobacco price from P_e to P_s (tobacco price with the quota). P_s can be observed from market data, but P_e must be estimated, which we did with a simple demand and supply model (Figure 2).

Equations 1 and 2 in Figure 2 represent demand and supply in the tobacco leaf market, respectively. Equation 3 describes the relation between the market price of tobacco and the net prices received by tobacco farmers. This equation shows that tobacco farmers pay an amount up to L to quota owners for renting their quotas. The rent paid by tobacco farmers to quota owners also represents the program benefit created by the government price support to tobacco. Because quota owners acquire all the program benefit, the tobacco price support program "subsidizes" the tobacco quota owner rather than the tobacco farmer. Equation 4 describes the market-clearing condition at which the quantity of tobacco demanded equals the quantity of tobacco supplied; these quantities both equal the national tobacco quota.

To estimate P_e (the tobacco price in the absence of the support program), we first estimated the values for α and β. To do this, we first collected information on Q_d, P_s, L, η, and ξ from the observed market data and previous literature (Table 1). Q_d and Q_f averaged 1613 million pounds per year between 1990 and 1994, and the average P_s was $1.76 per pound during the same period.[15] Results from previous studies indicated a value of –2 for η and a value of 7 for ξ.[8,9] L was $0.45 per pound based on a survey in the major tobacco production area.[1]

P_f was $1.31 per pound by applying the values of P_s and L to equation 3. We then applied the obtained values of Q_d, P_s, and η to equation 1 to solve for α and the obtained values of Q_f, P_f, and ξ to equation 2 to solve for β.

We used the estimated values on α and β and the values for η and ξ obtained from the previous literature to estimate P_e. The value for P_e was obtained by estimating P_s and P_f, because P_s and P_f were both equal to P_e when the tobacco market was at equilibrium. Q_d also was equal to Q_f at the market equilibrium. Applying those 2 market equilibrium conditions and the values for α, β, η, and ξ to equations 1 and 2 and solving the 2 equations for P_s and P_f yielded the value for P_e.

Changes in Cigarette Prices Resulting From Higher Tobacco Prices

The US cigarette manufacturing industry is oligopolistic; 5 manufacturers control almost the entire market.[16] As oligopolists, the manufacturers have substantial market power to influence the cigarette price. A recent study[17] showed that a state tax increase of $0.10 resulted in an average price increase of $0.11. We assumed that tobacco price increases resulting from the price support program would be fully (100%) passed on to the cigarette price at the retail level. If the actual increase in cigarette prices was more than the increase in tobacco prices, our calculation would underestimate the true increase in cigarette prices and the resultant reduction in cigarette consumption.

For a given unit of cigarettes (e.g., 1000), the change in its price attributable to a higher domestic tobacco price would equal the increase in the price of domestic tobacco per pound multiplied by the pounds of domestic tobacco used to produce that unit. The quantity of tobacco required to produce 1000 cigarettes declined from 2.3 pounds in 1960 through 1964 to about 1.7 pounds in 1980 through 1984 for several reasons: filter-tipped and smaller-diameter cigarettes became more popular, new technologies allowed tobacco stems to be blended into cigarettes, and tobacco sheets were used more efficiently.[10] Because the amount of tobacco for 1000 cigarettes has been stabilized at 1.7 pounds since 1984,[15] we used this ratio in the present study.

US cigarette manufacturers use both domestic and foreign tobacco. Foreign tobacco can be blended into a cigarette to make it more desirable to consumers and to reduce production costs. The shares of domestic tobacco without the price support program would be higher than those with the program because of the lower price of domestic tobacco in the absence of the program. We decided to use an estimate of the domestic share without the program to obtain a more conservative estimate of the cigarette price increase resulting from the price support program.

Predicting with reasonable accuracy what the share of domestic tobacco in US-produced cigarettes would be without the price support program presents substantial problems. In 1994, imported tobacco accounted for about 37% of US tobacco use (imported oriental tobacco constituted 12% of that use; imported flue-cured and burley tobacco constituted 25%). We assumed that oriental tobacco would continue to be imported if a price support program did not exist because the United States does not produce this type of tobacco. We also assumed that importation of flue-cured and burley tobacco would decrease without the price support program because of the decrease in the prices of these types of domestic tobacco. Still, foreign flue-cured and burley tobacco would probably continue to cost less than the domestic variety, and, thus, imports of these tobaccos would surely not end altogether. In addition, removal of the tobacco price support program might be combined with an import tariff reduction, in which case tobacco imports would be expected to increase.

After considering these factors, and after a discussion with an expert at USDA (T. Capehart, oral communication, August 1997), we decided to use 75% as the value of domestic share of US tobacco use in the absence of the price support program for this analysis.

$$(1) \quad Q_d = \alpha \times P_s^{-\eta}$$

$$(2) \quad Q_f = \beta \times P_f^{\xi}$$

$$(3) \quad P_f = P_s - L$$

$$(4) \quad Q_d = Q_f = \bar{Q}$$

Note. Q_d = quantity of tobacco demanded; Q_f = quantity of tobacco supplied; $\bar{Q}$ = tobacco quota; P_s = market price of tobacco; P_f = minimum price of tobacco to cover farmers' marginal costs of production; L = lease rate of tobacco quota; η = price elasticity of demand for US tobacco; and ξ = price elasticity of supply for US tobacco. α and β are constant parameters to be estimated.

FIGURE 2—A market equilibrium model for US tobacco leaf.

Changes in Cigarette Consumption Resulting From Higher Cigarette Prices

We estimated the percentage of reduction in cigarette consumption resulting from higher cigarette prices by multiplying the percentage of change in the cigarette price by the price elasticity of demand for cigarettes. Estimates of the price elasticity of demand for cigarettes at the retail level range from –0.28 to –0.80.[18–24] An expert panel of the National Cancer Institute recommended using –0.4 as the short-run price elasticity for such demand,[25] and we used this value in our study. We assumed that the long-run price elasticity of demand for cigarettes is about 1.5 times the short-run price elasticity[18–24] and thus used a value of –0.6 for this measure. We also converted the annual percentage of decrease in cigarette consumption resulting from the price support program into the decrease in the number of packs of cigarettes consumed per year.

Sensitivity Analysis

Values of the parameters used in the analysis still could be associated with uncertainties in spite of our efforts to incorporate the most likely value. We conducted a sensitivity analysis to address those uncertainties. Our sensitivity analysis focused on 2 scenarios—the maximum and the minimum effect of the tobacco price support program on domestic cigarette use.

We applied the following assumptions in estimating the maximum effect: (1) increasing or decreasing the values of price elasticities of demand and supply for tobacco leaf and price elasticities of demand for cigarettes by 50% in the direction favoring the maximum effect, (2) assuming that no tobacco imports would occur without the tobacco price support program, and (3) using the upper bound of the rent value for tobacco quota ($0.50 per pound).[1] In estimating the minimum effect, we (1) increased or decreased price elasticities of demand and supply for tobacco leaf and price elasticities of demand for cigarettes by 50% in the direction favoring the minimum effect, (2) assumed that tobacco imports would increase up to 40% of the total tobacco use, and (3) applied the lower bound of the rent value for tobacco quota ($0.40 per pound).[1] The parameter values used for the sensitivity analysis are presented in Table 1.

TABLE 1—Parameter Values Used in Estimating the Direct Effect of the Tobacco Price Support Program on US Cigarette Consumption

Parameters and Measuring Units	For Deriving the Most Likely Effect	For Sensitivity Analysis	
		Maximum Effect	Minimum Effect
Quantity of tobacco demanded and supplied, and tobacco quota (Q_d, Q_s, and $\bar{Q}$), million lbs	1613[a]	1613[a]	1613[a]
Market price of tobacco (P_t), $/lb	1.76[a]	1.76[a]	1.76[a]
Lease rate of tobacco quota (L), $/lb	0.45	0.50	0.40
Price elasticity of demand for tobacco leaf (η)	−2.00	−1.00	−3.00
Price elasticity of supply for tobacco leaf (ξ)	7.00	10.50	3.50
Tobacco leaf required for producing 1000 cigarettes, lbs	1.70	1.70	1.70
Importing share of total tobacco use	0.25	0	0.40
Short-run price elasticity of demand for cigarettes	−0.40	−0.20	−0.60
Long-run price elasticity of demand for cigarettes	−0.60	−0.30	−0.9
Price of cigarettes, $/pack	1.76	1.76	1.76
Cigarette consumption, billion packs	24.25	24.25	24.25

[a]Average values between 1990 and 1994.

Results

We estimated that the price of tobacco at market equilibrium level without the tobacco price support program was $1.40 per pound—$0.36 less than the average $1.76 per pound received by farmers between 1990 and 1994.[15]

We used a $0.36 decrease in the tobacco price in the absence of the price support program, the estimate that 1.7 pounds of tobacco yield 1000 cigarettes, and a 75% market share value for domestic tobacco to estimate that the price support program increases the price of 1000 cigarettes by $0.46, or $0.009 per pack. The average retail price for a pack of cigarettes was $1.76 in 1994,[26] so this represents a 0.52% increase in the price.

We estimated that this 0.52% increase, if short-run price elasticity is −0.4, reduces cigarette consumption by 0.21%. In 1994, 24.25 billion packs of cigarettes were consumed in the United States.[28] If this represents 99.79% of what consumption would be without the price support program, total consumption in 1994 without the program would have been 24.30 billion packs. On the basis of this level of consumption, a 0.21% reduction in cigarette consumption per year due to the direct effect of the system-induced price increase of the tobacco support program is equivalent to an annual cigarette reduction of 51 million packs, or just a pack per smoker per year. In the long run, the reduction in cigarette consumption resulting from the direct price effect of the program is 76 million packs per year, or fewer than 2 packs per smoker per year, according to our model.

Results from the sensitivity analysis showed that under the assumptions of the maximum effect, the tobacco price support program increases the price of a pound of tobacco leaf by $0.46 and the price of a pack of cigarettes by $0.016. Cigarette consumption is reduced by 0.53% in the short run and by 0.80% in the long run as a result of the program. In contrast, under the assumptions of the minimum effect, the tobacco program increases the price of a pound of tobacco leaf by $0.20 and the price of a pack of cigarettes by just $0.004. Cigarette consumption is reduced by only 0.05% in the short run and by 0.07% in the long run as a result of the tobacco price support program.

Discussion

This study suggests that the tobacco price support program increases the price of tobacco leaf by $0.36 per pound, which was 21% of the tobacco price in 1994. This result is consistent with that in the earlier report of Sumner and Alston.[7]

This higher tobacco price translates to a 0.52% increase in cigarette prices. The fact that a relatively large percentage increase in tobacco prices has led to a small percentage increase in cigarette prices suggests that tobacco prices received by farmers and retail cigarette prices are very weakly related.

The small increase in cigarette prices may or may not have a real effect on reducing smoking, depending on the sensitivity of smokers to a small price change. Assuming that smokers are price-sensitive to a small price change, the higher cigarette prices resulting from the price support program would reduce both smoking prevalence and the number of cigarettes that continuing smokers consume. Previous studies indicated that at least one half of the reduction in consumption from an increase in cigarette prices results from a decrease in smoking prevalence, and that the other half is from the reduced number of cigarettes consumed by continuing smokers.[22,24,27] In 1994, on average, a smoker consumed 23.19 cigarettes per day,[28,29] a value adjusted for underreporting.[29] If 50% of the reduction in cigarette consumption were due to the reduced number of cigarettes smoked per smoker, a reduction of 51 million packs would be a decrease of 11 cigarettes per year (0.13%) per smoker. Similarly, if one half of the reduction in cigarette consumption were due to the decrease in smoking prevalence, there would be a reduction of 0.13% (60 000) in the number of US smokers.[28]

The reduction in cigarette consumption accruing from the tobacco price support program could have a health benefit, particularly if smoking prevalence is reduced.[30] The health benefit from reducing the number of cigarettes consumed by a smoker is less clear, because smokers may compensate by increasing the depth of inhalation or by smoking more of the cigarette.[31] In any case, the very modest reductions in cigarette consumption that we found suggest that any health benefit that might result from the tobacco price support program is likely to be quite small.

The potential health benefit of the tobacco price support program from reducing cigarette consumption is minimal compared with that of virtually all tobacco policy measures.[4] For example, a $0.02 per pack increase in federal excise taxes would reduce cigarette consumption more than the price support program currently does. This is true even when the most conservative estimate under the maximum-effect scenario is used.

For proponents of tobacco control, this small direct effect of the tobacco price support program on cigarette consumption also must be weighed against the potential indirect adverse political effect of the program on reduc-

ing tobacco use. The tobacco price support program creates an additional political force (quota owners) that is likely to oppose tobacco control measures, and the program also changes the political influence of tobacco farmers by keeping many tobacco farmers in tobacco production.[32] The increase in potential opposition to tobacco control measures resulting from the additional political force created by the tobacco price support program could block policies such as a cigarette tax increase or other tobacco control initiatives.[4] Thus, it is very likely that the indirect political effect of the tobacco price support program on tobacco control far outweighs the direct program effect on reducing cigarette consumption.[4,32] □

Contributors

P. Zhang planned the study, conducted the analysis, and wrote the paper. C. Husten contributed to the analysis and the writing of the paper. G. Giovino contributed to the writing of the paper.

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